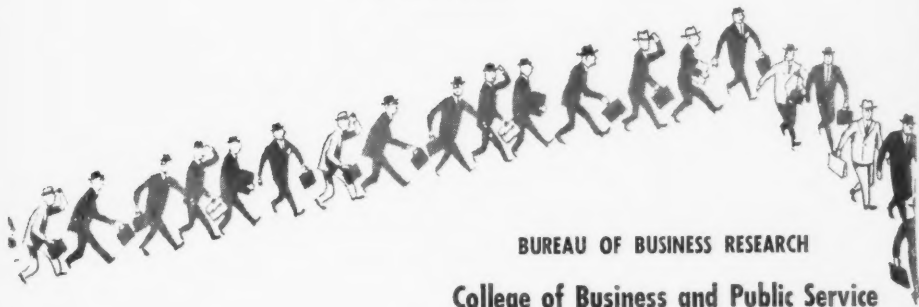


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BUREAU OF BUSINESS RESEARCH
College of Business and Public Service
MICHIGAN STATE UNIVERSITY
EAST LANSING

Research Aid For Small Business

This definitely is the business era of research. Every substantial manufacturer has long utilized physical research in the development of products and the planning and control of production. Now large businesses widely apply research to other aspects too—personnel, marketing, finance and organization. Their managements find research basic to success against today's competition.

It would seem that the small business cannot afford research talents. Of course its manager can directly observe its compact operation, needing less research for its control. But small businesses too have their major decisions requiring research rather than guesswork. The problem is how to get facts without prohibitive cost.

A wealth of useful facts already exists. Where to look for such facts is such a universal question that *Business Topics* will shortly devote a whole article to this. At this time we speak only of the related question: How can small business get original research done (no such facts having been already collected) for reasonable cost?

One obvious suggestion is to join with similar businesses to pool their funds for research. Frequently their trade association can serve the particular industry either by sponsoring the research or, where it does not require too much staff, conducting it.

Another suggestion is: Why not ask a university business research bureau? Surely a main purpose of such bureaus is to draw upon the university's resources to serve businesses. Often these bureaus cannot work privately for a single firm, as in state-supported institutions, but they could nearly always serve firms through their trade associations. And whether or not a university bureau proves to be able to conduct needed research, its advice is free for the asking.

In particular, we want to suggest that the Bureau of Business Research, Michigan State University, is pleased to be of such service.



Vol. 3 November, 1955 No. 3

"Let your discourse with men of business be short and comprehensive."

(George Washington's *Copybook*).

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JUNIOR ENGINEERING TRAINING FOR SCHOOLS

By LORIN G. MILLER and HAROLD P. SKAMSER*

A JET-propelled idea for encouraging an interest in engineering among high school students is here described by the men who have been closest to it.

Despite an abundance of counselors, books and bulletins on engineering available in many high schools, administrators and leaders of college studies in this field had long been concerned about the unfilled demand for young engineers. The trouble went back to the high school level, for election of mathematics and related courses was on the decline. A further subject for dismay was the caliber of some of the students who were attracted to engineering studies by a wistful misconception about its glamor and their own ability. The problem had two aspects: to bring the actual scope and demands of an engineering career to the attention of competent high school students (and incidentally to keep this interest, once aroused); and to discourage, by the substitution of facts for fictions, those who were not intellectually equipped for the rigors of college work in engineering.

The working idea for JETS, or Junior Engineering Training for Schools, originated in 1950 with one of the co-authors, then Dean of Engineering at Michigan State College. Pondering the success of the 4H Clubs in fostering agricultural interest and skills in youngsters, he projected an organization that would do the same for potential engi-

neers. The idea was—and is—to substitute a lively and versatile program for the bare presence of reference material and counselors in the high schools, thus capturing the imagination of students by a chance to participate rather than to listen or take notes. Stimulating as the program is, it has the further—and greater—advantage of enabling young students to measure their talents and abilities against the requirements of the profession.

The first JETS club was organized at East Lansing High School in November 1950. The first secretary of the club, John Rood, has just graduated from Engineering School at Michigan State University, with a distinguished record. He won a slide rule for attaining the highest scholastic average in his freshman class. He was president of Tau Beta Pi, the top engineering honorary society, and a member of several others. He was active in the engineering exposition, and on the staff of the Spartan Engineer magazine.

Extent

Although still young, the JETS program has now spread until there are approximately 60 clubs scattered over eleven states. While the majority are in Michigan, clubs are found from Idaho to Tennessee. Most are sponsored by high schools and assisted by the College of Engineering at Michigan

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Belleville, Michigan JETS Club. Their emblem was designed by Vernon Baker, a member.

State. Thousands of young people have been members of this organization.

JETS have successfully operated in a great variety of schools and communities. Sparse and dense population areas, junior and senior high schools, rural and urban interests all have produced successful clubs. The interests, projects and activities are as diverse as engineering itself. Success of the JETS program has brought appeals for information about the clubs from industrial leaders and educators from all over the United States, and from three foreign countries as well.

Activities

JETS members come to college with much better orientation by virtue of the first hand participation in nine or ten major types of activities. They have sampled the main fields of engineering

through lectures by professional engineers, trips to industrial plants and construction jobs, attendance at movies and special radio programs, study of engineering guidance literature and tours of engineering schools. Of their own initiative they have presented engineering and scientific programs in school assemblies, and undertaken simple jobs of a technical nature as a service to the school or community. In the spring of each year they have a Big Brother Day in the field, or on the job, with a practicing engineer.

To further stimulate original thinking and activity, there is a yearly contest for the display of projects, where they are judged for originality, scientific accuracy and general engineering thinking. Up to this present time, the contests and displays have been assembled in the engineering buildings at Mich-

igan State University during the Engineers' Open House. Prizes are awarded the winning contestants. These include scholarships, drafting instruments, slide rules and other tools of the profession.

Advisors

In order to be educationally valid and at the same time to follow established engineering procedures, the clubs are guided from two sources. A high school staff member, preferably from mathematics, science or vocational training, offers liaison between the participants and the educational administration. A consulting or practicing engineer from the community forms the link between the students and the profession. The faculty member oversees the method of investigation or research and assists in perfecting the finished product. He also is of service in maintaining a balance between the severity of the problem attacked and the ability and energy of the student. The engineer member secures admission into various engineering activities to be observed, provides engineering data and guides in professional methods. The two men collaborate in advising the members as to mathematical, scientific and elective courses which will best prepare them for a career in engineering.

How do the advisors feel about JETS?

"This is the greatest challenge I have experienced in many years," confided a veteran mathematics instructor and sponsor of a 25-member club in Traverse City, Michigan. "Some of the boys are way ahead of me in their chosen interests and I'm amazed at the technical vocabulary they use." This enthusiasm is matched by that of the boys themselves. For example, a member of the Okemos, Michigan club has

stated enthusiastically: "The JETS club program has exceeded my highest hopes and surpassed anything I dreamed of as far as benefits to the individual members are concerned. It certainly is worthwhile to us as future engineers."

Aid From Headquarters

To help new clubs get started and to continue to serve with information and exchange of ideas, JETS headquarters has amassed a helpful store of material about engineering. It is a clearing house for literature from industry, outlines for projects and information about progress of other JETS clubs. Over 100 industries such as General Electric, Westinghouse, General Motors and DuPont have been most liberal with publications attractive to youth. Many of these pamphlets would not find their way into the hands of the boys without some intermediary like JETS. Faculty members of schools of engineering, consulting and practicing engineers have been extremely helpful in outlining problems and projects or suggesting and explaining the steps in the procedure. The materials from industry and the profession are distributed from the JETS office at regular intervals along with a JETS-O-Gram newsletter.

Effects and Evaluation

While one is prone to interpret increase in numbers of clubs, enrollment of students and excellence of projects as success, the real value must appear as an increase in the numbers of talented students successfully engaging in advanced mathematics and science courses. This has been invariably true in schools where JETS are active. JETS stimulates interest in engineering, encourages good scholarship and

proficiency in high school. As a prerequisite for college engineering courses it aids the student in discovering and appraising his own abilities, aptitudes and interests.

The JETS organization offers eight types of services or aids to its clubs: 1) club operation materials, pins and jackets; 2) program features; 3) prepared projects and ideas for projects; 4) visits by engineers; 5) engineering career information; 6) guidance information; 7) specific field data; 8) new ideas and basic facts. The JETS library (for clubs) consists of approximately 20,000 pieces of literature and over 420 different titles.

Thus the importance of mathematics and other rigorous aspects of engineering are emphasized, and an accurate picture is given to youngsters of the demands put upon the college engineering student.

JETS has shown definite signs of increasing the number of students interested in mathematics, engineering and similar scientific studies, producing alert and well-prepared graduates who have been planning on this type of career since high school days. It is a means of funneling qualified talent into college and into industry at a higher level. This end is also served by scholarship data. Brian Elmer and David McDougall from the first East Lansing club learned about scholarships at Cornell and MIT through JETS, and won generous grants which they said they would never have known about except for JETS.

The University provides added incentive to JETS members through its own scholarship program, offering to the outstanding student in each club four years' tuition at MSU.

The program is proving effective not only in stimulating interest about engi-

neering but also in another important way: it steers some students who have misconceptions about engineering and whose talents are in other areas, away from engineering. This aspect of the program tends to reduce engineering "drop-outs".

Breadth of Interest and Support

Interest in JETS has spread throughout the profession as well as among students. Professional engineering societies, colleges and universities and educational foundations have expressed an interest, and some of them are sponsoring JETS clubs in their own localities. For example the state Engineering Society, Louisiana State University and Tulane are cooperating in forming JETS clubs in Louisiana. In New York state, General Electric has formed three engineering clubs in the vicinity of its home office, and sent information about the JETS program to its district offices.

How to Start a Club: A card or letter of inquiry to JETS, P. O. Box 470, East Lansing, Michigan, will bring a packet of information on how to start a JETS Club, the nature of the program, and what can be done with it. Assistance, information and advice are almost automatic from there on.

Conclusion

JETS has been a labor of love, but it might become a national institution, involving the participation of accredited engineering schools. With former JETS members now students in engineering colleges throughout the Middle West and East (many of them on scholarship), the time is not far off when these qualified men will be entering the profession. Then the JETS program will be proving, in the competition of the profession, the efficacy of its service to future engineers.

SYSTEMS NEED CHECK-UPS TOO

By BERNHARD C. LEMKE*

As the title implies, this is a reminder to executives.

The average American citizen is well aware of the existence of check-ups! Almost everyone has been told, many times, that he should see his dentist every six months and his doctor once a year; then too, whenever he drives his automobile into a service station the attendant automatically checks the water and oil levels. These and many other check-ups usually uncover nothing new or startling and yet that in itself is worthwhile: the known facts of the situation are updated, presumably in time to practice "preventive maintenance" had such a need been uncovered.

A business needs periodic check-ups too. There is a natural tendency toward complacency when everything seems to be running smoothly and profits are comfortable in size. It is human nature to wait until an upsetting event occurs before doing any real trouble-shooting. This is likely to be so in the case of office systems. Many businessmen are alert to changes, good or bad, in sales and production, and will spend a lot of their time and energy in the study of ways to improve these two important areas. These same businessmen often are seemingly indifferent about the condition of the balance of the business operations, which are concerned largely with the internal functioning of the business.

This is unfortunate because the highly competitive atmosphere in which business is presently conducted increases the area in which competitive advantage or disadvantage is likely to

be found. Competitive pricing of product, aggressive salesmanship, and efficient production quite obviously are essential factors in winning and keeping a fair share of the market, and yet many of the encounters with a company which the customers and would-be customer will have will be with the office system of the company—the bookkeeping, accounting, collection, credit, clerical, and similar departments. A satisfied customer can become a dissatisfied customer because of the way his account, inquiries, complaints, suggestions, and routine transactions are handled. The office system can undo much of the good done by other units of the business as well as do its work at a higher cost than necessary or fail to supply desired information within reasonable accuracy and time limits. The only way these things can be prevented is to check up on the office system in a positive and controlled manner, according to a program.

A Schedule Advisable

There are advantages in scheduling check-ups in some sort of cyclical yet flexible pattern. This assures a comprehensive coverage of all elements of the system within a uniform period of time. It also can be of considerable value in building good morale among employees because good work is likely to be recognized as an inevitable by-product of a systems review. If, on the other hand, check-ups are sporadic, employees may rightly or wrongly associate them with witchhunts, and react accordingly.

The carrying out of a program assumes that the personnel engaged in it

*Dr. Lemke is Professor of Accounting, Michigan State University.

have the necessary background and knowledge to know what should exist in the areas to be covered; the ability to find out what does exist; and finally the capacity to analyze and to suggest corrective action where necessary.

The Situation Study

Finding out what does exist involves the skillful use of audit techniques consisting largely of observations, samples, tests, questionnaires, and interviews of the variety and to the extent considered necessary to substantiate findings; these are summarized into reports which at this stage are largely descriptive in nature. In order to complete the reports and make them meaningful it is necessary to analyze the data which have been gathered in a constructive manner and to recommend corrective measures where such are indicated. This completion stage is the really difficult part of the operation because it requires knowledge of what *should* exist.

What should exist is largely the responsibility of management and it cannot be satisfactorily delegated to others. Management must specify the services and information which the system should provide and then decide which procedures are best suited to accomplish these objectives. Because there is a cost attached to all procedures, the value of individual services and information must be measured against the cost. Since neither values nor costs remain static over time recurring check-ups offer opportunities to reappraise the service and information functions in the light of new developments in methods and machines.

Designing the System

Management normally indicates what it wants from the office system. The process of establishing procedures for

satisfying these wants, however, is usually accomplished by management working with staff personnel qualified in this work, or with outside experts, or with a combination of both. Enough of the basic routines are reasonably uniform throughout business so that each system is a combination of standard features as well as custom-made ones. Complete standardization is not possible because management itself is not standardized.

The design of the system is also influenced by the size of the business and the industry of which it is a part. As a company grows or shrinks the procedures must undergo radical changes even if the requirements do not change and although all companies within an industry tend toward some uniformity substantial differences can be found between industries. The art of management as practiced in large corporations seems to be undergoing rather significant although not abrupt changes as a result of fairly recent development in the systems field. These changes will have their effect on all companies, however, small as well as large.

Recent Developments: These changes are brought about by the accelerated and intensively competitive drive in the post-war years to mechanize systems work wherever possible. The electronic computer is the most spectacular development to date although it tends to overshadow some rather solid accomplishments of a less dramatic nature. The electronic computer as used in business is a modification and refinement of a complex machine used to solve involved scientific problems of a mathematical nature during the war years. At present an integrated electronic computer system is an expensive assortment of equipment, whether pur-

chased or rented; but both cost reduction and adoption to moderate size businesses is inevitable. An excellent article on electronic computers can be found in an earlier issue of *Business Topics*.¹

Speed and accuracy, which are presently attained to a superlative degree in the electronic computer, are also the objectives of clerical and bookkeeping machines designed for more general use. Many of the developments incorporate the objective but not the method of the peg-board technique. In this method several related and coordinated forms and records are carefully positioned with the aid of peg guides so that all can be prepared or brought up to date at one writing by use of carbon papers.

Repetitive writing and handling is somewhat similarly reduced through the use of machines which prepare a punched card or tape as an automatic by-product of the first recording of the transaction. This record on tape or card at the point of origin must be correct in all respects because all subsequent recordings and notations pertaining to the transactions are made from it. An order from a customer, for example, need be written up just once because the invoice, shipping notices, follow-up documents, sales posting and tabulations and other related operations can be prepared or performed by inserting the tape prepared upon receipt of the order into the various integrated machines of the system.

For maximum efficiency, all components of the system should be compatible in the sense that they all use a "common language" or code. Codes

are by no means standardized although that is not an insurmountable difficulty because machines have been designed which convert tape from one code to another code.

Still other machines can convert paper tape to punch cards or to magnetic tape (for use in electronic computers) or combinations of these media, although no one machine so far will make all of these conversions. Machines also have been designed to transmit code by wire, thus making it possible to link branch offices to a centralized processing center. High speed printers and typewriters can also be brought into the system and are operated directly from the tape.

Management Benefits: Increased speed and accuracy of data processing inevitably increase managerial efficiency. Management in many instances by using the newer machines and procedures can now obtain analytical information about current transactions in time to use it for immediate planning and control. Less reliance will have to be placed on intuition or conclusions derived from incomplete facts.

If, by way of illustration, up to date sales and inventory data at various points along the channel from production to final distribution are available to a manufacturer for integration into forecasts and budgets, then production, inventory, and financial policies can be adjusted in time to minimize over or under production problems with their resultant difficult inventory positions. If a company is able to speed up gathering and disseminating information useful in making managerial decisions it then is in a decidedly better competitive position than a company which must wait for this information or make a decision without it. For this reason alone, systems check-ups may prove to

¹Leonard Spacek, "The Electronic Computer," June, 1955.

be more important now than at any time in the past.

Who Should Appraise the System?

The actual method of appraising an office system for possible revision of existing procedures and mechanization, once management has set the goals, depends somewhat on the size and complexity of the company. The large company, on one end of the scale, will probably have a permanent internal audit staff with its related procedures and methods section which will review all major units of the company at least once a year on a rotating basis. The smaller company at the other end of the scale will probably select a committee or designate an employee from among its regular staff personnel to perform the work as a temporary assignment.

A company or its employees assigned to this area can join several national societies and organizations that are active in this area. These serve as an excellent means of keeping abreast of current developments and new ideas.

No matter what form of internal organization is used to perform the reviews, the objectivity and validity of the end result will be substantially improved if consultants are brought in from the outside at some point in the program, particularly if conditions

seem to suggest the need for a significant revision of portions of the system.

Role of Consultants: Consultants can be selected from among business equipment manufacturers, management consultants, and accounting firms. Excellent advice can be obtained from business equipment manufacturers through their various service departments. In order to obtain the maximum benefit from this approach information should be obtained from all manufacturers whose machines fit the classification selected. Management consulting firms perform a variety of services many of which include a review of office systems in part or in whole.

The accounting firm, particularly the one which certifies the financial statements of the company, usually brings to a system review or check-up a detailed and prior working knowledge of the company and the industry of which it is a part as well as the desire to suggest revisions of procedures which will help to reduce annual audit fees. Many of the accounting firms have systems specialists on their staff.

But no matter what method is adopted to carry out the work, the ultimate responsibility for the system rests with management and to a certain degree the system is a real reflection of its overall ability.

HOUSEHOLDER, SAVE YOUR CHILD

Doctors say your child is never in greater danger than when he is safe at home. Far more children are killed or injured there than upon the highway. Home conditions contributing to accidents include poorly-lighted stair landings, worn stairs and faulty electric wiring. Many such conditions, tolerated in homes, would be regarded as criminal in factories. Probably few homes could stand five minutes of critical inspection by a factory safety officer.

TALL TALE FROM THE TITTABAWASEE

By ANNE C. GARRISON*

This, Number Thirteen in our series of Michigan industry articles, may amaze you.

The people up in Midland are used to miracles of industrial chemistry. As neighbors, associates and employees of The Dow Chemical Company for many years, they know that almost anything can come out of a test-tube. But even their credulity would have been strained, fifteen years ago, if some prophetic soul had pointed to a nearby cow pasture and told them what was going to happen there. A tall tale indeed he would have had to tell them—the sort of story associated rather with Paul Bunyan than with any product that could come out of Midland. Our imaginary seer would describe a new family of chemical marvels deliberately created to perform the impossible: to multiply the life of electric motors by ten, to finish and protect metals at 1000° F, to save the lives of cows, preserve brick walls and make leather laugh at rain. His audience could be forgiven for their scepticism, as nothing in the history of chemistry is more incredible than this story of the silicones. Yet it is a “tall tale” only in the sense that silicone towers into the sky as paint protecting smokestacks, and soars into the stratosphere with our bombers, and insures dry boots for mountain climbers. These industrial miracles are produced where the cows once grazed on the banks of the Tittabawasee, in a handsome modern plant of red brick, set in a network of green, orange and yellow piping and tanks.

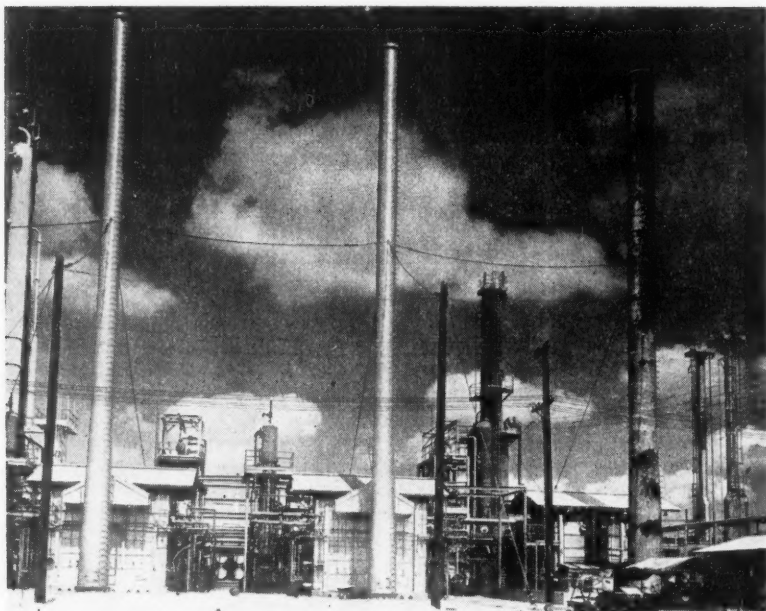
Dow Corning Corporation is the

*Mrs. Garrison is Associate Editor of *Business Topics*.

largest producer of silicones in the world (though there is evidence that the Russians are at work in this type of research, they have released no figures on their production). Starting from scratch with a wartime contract in 1943, the firm now employs 1000 people in Midland alone, and 150 more throughout the country. And silicone history is being written constantly; each month of research turns up new forms, and new commercial uses for the entire family.

What Are Silicones?

“Silicone” is a generic term for a compound based on a molecular skeleton of alternate silicon and oxygen atoms to which various organic groups are attached. It is produced from silica, brine, coal and oil, by processes involving catalysis, hydrolysis and condensation. The end product constitutes an entirely new class of semi-organic materials akin to both glass and plastics, but with a set of unique properties of its own: stability over an enormous range of temperatures, flexibility, resistance to oxidation, good electrical insulating properties, inertness to most organic materials and to many acids and chemicals, and a high order of water repellency. These various properties can be combined in different degrees and the physical forms can be varied to produce silicone fluids, compounds, greases, resins and rubbers tailor-made to solve thousands of specific problems. At present the silicone industry is turning up new products constantly, even before uses for them



These 50-foot high powerhouse stacks were repainted about two years ago. The one at the right started to rust six months after it was coated with a conventional aluminum paint; the other two stacks, painted with a silicone aluminum finish, are still in excellent condition.

have been discovered. One such is the so-called "Silly Putty" of a few years back. You can have a lot of fun with it (bounces better than rubber, shatters under a hammer blow, takes ink off newspapers, flows tiredly when left alone at room temperatures) but no serious employment has been discovered for it except as an exercise for weak hand muscles.

Long History, Short History

Such a monument to industrial chemical enterprise as the spruce-looking Dow Corning plant, producing at full blast a material the country didn't even know it wanted fifteen years ago, must have quite a history. Depending upon the point of view, you

can say that it is a very long history or a very short one. As the name silicone implies, the parent mineral is silicon, the main constituent combined in nature with oxygen to make common sand. As such, silicon is the most abundant mineral. It has been studied and used since antiquity, without being understood: the ancient Egyptians made glass with it but could not have told you anything about the nature of the material. The properties of silicon have fascinated scientists for thousands of years. Like a good servant who is yet no slave, it could be turned to certain uses but was very resistant to other treatment. Few acids could affect it, nor could any but the hottest fire melt it, but when mixed with ashes it

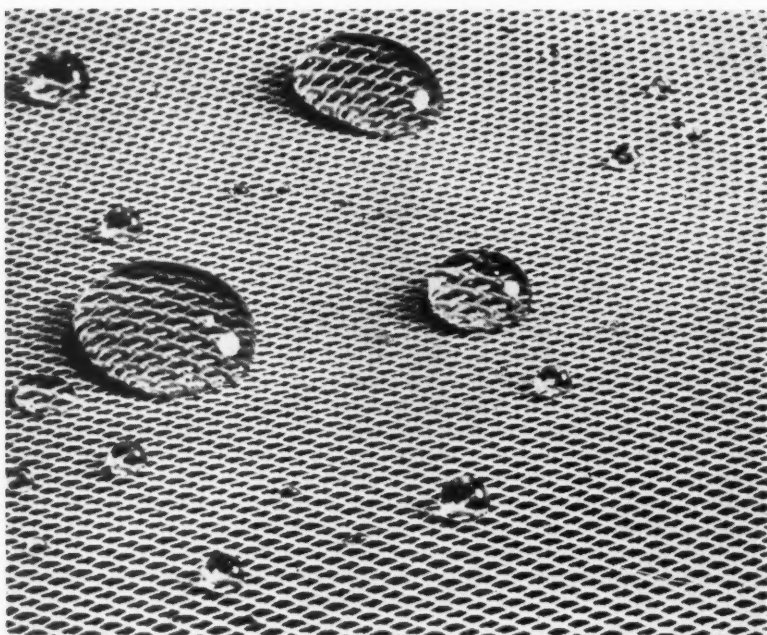
would melt more easily. What was this mineral, the ancients wondered; was it perhaps a form of ice frozen at extremely low temperature? Let us not laugh at such scientific simple-mindedness: they could do something with silicon that is still beyond us. Shatter-proof glass was a secret that died with the Roman empire.

Mediaeval alchemy, in vain pursuit of a way to turn base metal to gold, did not waste its ingenuity on common white sand. Even the rise of scientific chemistry did not contribute much to the knowledge of silicon until 1824, when Berzelius succeeded in isolating this element and investigated some of its properties. It continued to be the subject of sporadic research, its usefulness as a base material for synthesis gradually coming to light. Compounds of silicon and carbon were important developments, later in the century, anticipating by scores of years the more purposeful silicon research of recent times. In retrospect it may be wondered why progress in this field was not faster. The fact is that pure research is not a reversible process. To view it on the basis of later progress is to misunderstand the circumstances under which it takes place. It is not a groping toward a difficult goal, but a pathless exploration, with the goal maybe just at hand or a hundred miles away—or there may be no goal at all. The purpose of nineteenth century silicon research was to study the chemistry of silicon, not to prepare compounds on it, except to the extent that the compounding would shed light on other questions. So understood, the study of compounds, which has been so fruitful in industrial chemistry, was just an interesting digression.

Sticky Things and Uninviting Messes

Professor F. S. Kipping's name is famous in the research field. Beginning in the 1890's, this English scientist spent the active years of his life on the chemistry of silicon compounds, and published over fifty papers on them, but like earlier investigators he was interested solely in the problems of pure research. Though he actually produced many different compounds on silicon, his work preceded the development of high polymer chemistry and he was unable to find practical industrial applications for them. In his papers he described with vivid distaste the "glass-like messes," "gummy substances," and "uninviting sticky things" which his experiments turned up. Today these gums and glops are the materials of Dow Corning's magical products.

The point at which silicon studies intersected another line of research, the investigation of large molecules or polymers, is the point at which practical industrial application became possible. This stage was reached in research at the Corning Glass Works in Corning, New York, during the 1930's. There was need for a bonding agent to fill the voids in fiberglass and make possible its use as a high-temperature electrical insulating material. The glass product itself had great possibilities, but could be no more satisfactory than the resins used to make it into a continuous, moistureproof insulating system, and all organic resins rapidly charred and disintegrated at high temperatures. Thus silicone came into the industrial picture in the form of superior resins. The enormous usefulness of the silicone family was dramatically pointed up by the success of this first commercial application, which greatly extended the life of electrical machines



Air passes freely through the open weave of a piece of silicone finished nylon marquisette, but even large drops of water will not wet or penetrate the fabric.

and made possible a 50% reduction in weight.

Such, in capsule form, is the history of silicon research from the Egyptian glass bottle for precious oil to the far more precious oils, greases, resins and rubbers that are made from silicon today.

Corning and Dow

Corning Glass Works, while realizing the extremely practical and immediate applications for the silicones, had no desire to combine organic synthesis with its full-time job of commercial glass making. Hence it turned to The Dow Chemical Company with its great reputation for research and engineering in the field of industrial chemistry.

Dow was an especially good choice because of its pioneering work in the derivation of magnesium from brine, an essential step in one of the processes for making silicones. The two firms immediately financed and launched Dow Corning Corporation, with such rapidity that by 1943, when the legal chores of setting up the new firm were still in the stage of completion, the firm itself had already erected a pilot plant and had five months of production behind it.

DC 4 was the first silicone to be made on a large commercial scale. This is a petroleum-jelly-like compound that is not affected by temperatures ranging from -40° to $+400^{\circ}$ F, and is electrically insulating, water repel-

lent and corona resistant. It was so successful in combatting electrical failures under conditions of high temperature humidity, ozone and corona that it was one of the factors making possible the flight of Thunderbolts across the wide south Atlantic in time to help tip the scales of victory in the north African desert. The armed services absorbed the entire wartime output of this and other Dow Corning products.

While this firm may justly claim the seniority in commercial production of silicones, discovery of new forms and applications of these chemicals was coming so fast that it is hard to say who was first with what. General Electric had been working along the same line of research, and back in 1938 its scientists had developed a methyl silicone insulation. Later they found a vaporous silicone compound that could waterproof paper, or ceramics, and make glass so waterproof that liquids would drain to the very last drop. This was used during the war to treat filters of gas masks.

Dow Corning's next wartime contribution was a glass fibre and silicone resin insulation for cables and electrical equipment. Stepping up of horsepower and reduction in size of motors were priceless advantages in submarines and aircraft, to say nothing of greater reliability and better fire resistance. The Navy's quick recognition of the advantages of this insulation won Dow Corning priorities for building the first commercial plant for the large scale production of silicones. Then came the end of the war.

Necessity the Mother of Invention

While Dow Corning rejoiced with the rest of the country, they would have been less than human not to recognize that they were out on a limb with their

only customer gone, a new plant to pay for, and new products to exploit in an untried civilian market. Here was the largest silicone plant in the world, out there in its cow pasture with no customers. The fact that they made a market bloom where no market bloomed before is a tribute both to their inventiveness and the versatility of their material.

Really Clean Glasses, Really Dry Shoes

Having lost Uncle Sam, Dow Corning went straight to his nephew, the ultimate consumer, took his bifocals off his nose and cleaned them as they had never been cleaned before. No one who has once looked through glasses polished with Sight Savers will even again be without these little sheets of tissue—nor need he be, for distribution is nation-wide. By depositing an invisible film of dimethyl silicone on the lens, they create a brilliant surface that's easy to keep clean. The same treatment can be applied to any uncoated glass lens or reflector.

With the introduction of Sight Savers, there was inaugurated the use of Dow Corning's characteristic and easily-recognizable free-form label which appears on all its products. The consumer can find it on the hang-tag of his water- and stain-repellent slacks and golf jacket, on the tag that identifies upholstery and silicone finished to give it an "invisible slipcover," or on a bottle of Shoe Saver that makes his shoes and boots as water-resistant as leather can be made without clogging of the pores. But he is more likely to enjoy the benefits of Dow Corning's silicones without knowing it. The consumer gets a better tire, more efficient railroad service, fewer flight delays, a more accurate dosage of penicillin, a

better loaf of bread, a more beautiful and more practical fabric, a safer tent, a permanently dry Royal Coachman for his trout fishing. He may not realize at all that Dow Corning is responsible for these amenities.

The Manufacturer of Silicones

Before going into the properties and applications of the silicones, a word about their manufacture may be in order. The basic ingredient, silicon, is the second most plentiful element on earth, and the most plentiful mineral, yet it never appears alone in the natural state. Combined with oxygen, the most common element, it covers at least a quarter of the earth's surface. The first problem is to isolate the silicon from silica that makes up sand, quartz, sandstone or quartzite. To follow in detail one of the alternative methods of manufacture of silicone, the catalytic direct process, we can go to a corner of the Dow Corning property and observe their new electric smelting furnace pouring off a tap of 98% pure metallic silicon. Among all the drama of smoke and blinding light associated with Wagnerian opera, the liquid metal streams out of a furnace heated by an arc from three carbon electrodes, each 27 feet long. The electric power consumed in one hour would serve the needs of an average home for three years, for the extremely high temperature of 3100°F must be maintained to reduce the extremely hard quartzite rock with coke and charcoal.

Once cooled, the metal is brittle and shiny as silver. It is then ground to powder and reacted in the presence of a copper catalyst, with chemicals derived from oil and brine. Chlorosilanes, the products of this reaction, are then separated by distillation and fraction-

ation, hydrolyzed, and finally polymerized. This method is referred to as the "direct process." There are a number of variations on the direct process for making various silicone products. Dow Corning also employs another method for producing chlorosilanes, the building blocks with which silicone products are made by hydrolysis and polymerization. Based on the Grignard reaction, this latter method involves the use of ether and magnesium chips.

A Variety of Marvels

The best way to consider the silicone family is to break it up into groups, keeping in mind that their story is not in the stage of live-happily-ever-after conclusion, but still in its introductory chapters. We know their characteristics and many significant applications have been developed, but it's still impossible to say how much more extensively they may contribute to the American economy. Any definitive statement on what they can or cannot do may be outmoded a month from now.

Rubbers. Silicone rubber, or Silastic, as Dow Corning labels its own product, withstands high and low temperatures far beyond the limits of either organic or synthetic rubber, being serviceable over a span of more than 600° Fahrenheit. It is also superior to natural rubber in its resistance to weathering, oxidation, ozone and to a variety of hot oils and chemicals. Silastic stocks and pastes as well as gums are produced for a wide variety of uses. They are formed, vulcanized and cured to make parts that seal bomb-bay doors on high altitude bombers, prevent formation of ice on air-intakes of jet engines, guard against water leakage in domestic steam irons and serve as elec-

trical insulating materials for cable and traction motors. The only barriers to a wider employment of such superior material are its present cost and less mechanical strength at normal operating temperatures than conventional rubbers possess. Cost, however, is dropping and mechanical strength at room temperature is being increased steadily.

Greases and oils. One hundred years ago machine shop engine bearings were lubricated with lard. The instability of such a material limited machinery to simple designs. Petroleum and its family of lubricants removed many of the restrictions, but its own limitations are still apparent to anyone who has driven a car under conditions of extreme heat or cold. Modern machinery needs oils and greases that can take punishment no organic compound can withstand. How do the silicones measure up? They evaporate more slowly, thin out less at high temperatures, and thicken less at low temperatures than organic lubricants. They resist oxidation that limits the life of other lubricants. Their lubricating properties, however, are different from those of conventional lubricants, and they must therefore be evaluated under specific conditions of use including speeds, loads, type of friction and the bearing metal surfaces involved. They make possible the use of permanently sealed ball bearings for motors exposed to high temperatures, weathering and humidity. An eloquent example of the usefulness of these lubricants is afforded by the record of Dow Corning 41 Grease in a plant where it is used in bearings of a conveyor system for baking the finish on electrical parts. Here it has proved to have twenty-six times the life of high-temperature organic greases. It has elimi-

nated the spoiling of products through the dripping of hot grease onto paint. It has cut the relubrication schedule from once a week to twice a year.

Polishes. Sight Savers are just one of a useful family. Silicone polishes make it fun to have a shiny car. They have so won the car-polishing public (that means all of us) that today almost every car polish contains them. The fun comes in the ease of getting a shine and the growing ease of restoring it because road dirt does not stick so tenaciously to a silicone surface. Same thing is true of furniture polishing, which still isn't as much fun as face-lifting a car's finish, because it is done indoors. But the result is just as pretty. Being the most durable of water repellent materials, silicones are real life-jackets for the surfaces they polish.

Water Repellents. Yes, silicones hate water with a permanence few materials can approach. Imagine what this quality means when applied to textiles. Textile finishing materials made by Dow Corning, for example, make it impossible for water to get through nylon marquisette with a weave as open as a window screen. It can't even wet the fibres. A drop of coffee on a piece of rayon sharkskin stands up in a ball, completely unabsorbed, and can be completely removed with a sponge or cleansing tissue without leaving a stain. Yet these silicone finishes do not clog the pores of a fabric. They are water repellent, not waterproof. A raincoat that is rubberized is hot and uncomfortable, while a silicone-treated one lets air through so the body can breathe. Silicone-treated snowsuits are both warm and dry, and will stay water repellent through repeated washing and dry cleaning. And as Dow Corning says of suit fabrics

treated with its Sylmer finishes, why carry an umbrella when you can wear one?

Other silicone water repellents keep rain from soaking through the walls of masonry buildings as no other material can, or prevent moisture from forming a conducting film over the surface of a perfectly good glass or ceramic insulator body.

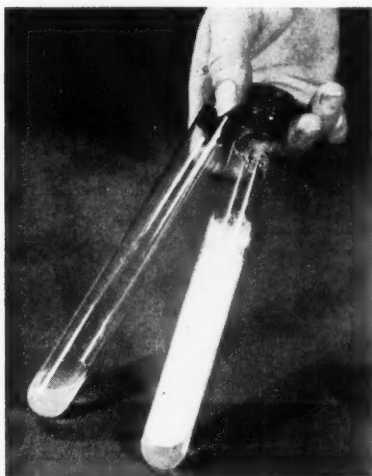
Fluids. Silicone fluids are imperturbable, like the most stable of your friends. They don't want to freeze solid or fly off as a gas; they are more unchangeable than any other kind of liquid. With freezing points in the range of 60 degrees below zero, they won't boil even at 500°F. Nor does mechanical action affect them. Most likely you are enjoying these properties in your car right now. If the pointers on your dashboard don't flutter the way they did a few years ago, there's a fraction of a drop of Dow Corning 200 Fluid on the pointer bearings. Torsional vibration dampers with a silicone fluid permanently sealed in smooth out the twisting action of crankshafts in diesel engines. If you have ever navigated a plane over the North Pole or the equator, the dependability of the bubble level in your sextant was due to the presence of silicone fluid.

Release Agents. A fancier term is *abhesives*: that simply means oils, greases, soaps or powders that prevent sticking. Here the silicones score 100%: in fact they have few competitors. They make hot new rubber tires drop out of their molds, thus reducing the rejects to the vanishing point, and cutting the cost of cleaning and maintaining the molds to 10% of its former figure. Sheets of silicone-treated paper, interleaved with uncured rubber stock, keep the rubber parts from sticking

together. Similar sheets release "brown and serve" and sweet rolls from the pans and make container liners for sticky materials like asphalt and tar. A silicone emulsion speeds up the new foundry process for casting metal in resin-bonded sand shell molds, improving surface finish and helping to maintain close tolerances.

An ingenious release agent called Pan Glaze pops hot loaves of bread out of their pans with the greatest of ease. This eliminates one of the baker's peskiest chores, the removal of charred grease from pans, since it is no longer necessary to grease them at all. Also eliminated is the choking and film-forming grease smoke that once made it hard to keep bakery walls, ceilings, floors and uniforms clean. The bread is better, too—and a single application of Pan Glaze is good for as many as 200 bakings. A similar product is used to keep waffles from sticking to waffle irons.

Defoamers. A curious use of the silicones is found in Antifoam A. Take a product that causes trouble in manufacture by its tendency to foam, add a few drops of Antifoam, and your trouble is over. Textile sizing and finishing materials, resin, hot caustic, soda, cold rubber, wine: there are thousands of materials that foam violently during processing. Antifoam A eliminates the waste and fire hazard due to foaming, permits more rapid processing and full use of processing tanks and kettles previously half filled with foam. Many a manufacturing procedure is being revolutionized accordingly. The product has the added advantage of being physiologically inert and safe to use at the low concentrations generally effective in food processing. Far from being dangerous, it has even saved many lives



A trace of Antiform A on the stopper of the test tube at the left has completely killed the foam in the soap solution even though it was shaken as vigorously as the untreated tube at right.

—cows' lives, that is: cows who were dying miserably of bloat. Time was when a cow swollen with a feast of certain grasses would die in agony. Experiments carried out by the Dairy Department of Michigan State University have demonstrated that a hypodermic of Antifoam A right into the gassy rumen induces a life-saving belch.

Protective Paint. A handsome feature of the Dow Corning plant is the use of varicolored paint on steam lines, water and oil pipes, and emergency equipment. There are three purposes back of this gaiety: it distinguishes among the various functions of the pipes and conduits in a complex maze, it makes the plant a more cheerful place to work, and it provides testing conditions for the durability of protective paints made with and without silicone resins. The difference in the life span

of the two types has been demonstrated many times over. For example, a silicone-based aluminum paint on a furnace flue has shown no wear after exposure to weather and to temperatures up to 1000°F for over a year. Three powerhouse stacks are conspicuous advertisements for silicone paint. All three were repainted two years ago, one of them with paint of a conventional type. Today it has rusted badly, while the other two, in their coat of silicone aluminum finish, are still in excellent condition. Such paints withstand temperatures that would blister organic paint in a few hours. The other properties of the silicones, familiar to the reader by this time, add to the heat stability of these new paints and gloss retention, weather resistance and water repellency.

Conclusion

It should be stressed again that this is far from being an exhaustive account of silicones. The uses described are typical of many other applications in all types of industry. Nor is Dow Corning the only manufacturer; indeed the competition is keen. The Midland firm was, however, the first commercial producer and continues to be the largest in the world. Its preeminence in this exciting new area has recently been recognized by its winning of the 1955 Award for Chemical Engineering Progress, sponsored by the magazine *Chemical Engineering*, published by the McGraw-Hill Company. An 84-man committee of senior chemical engineering educators chose Dow Corning to receive this coveted recognition. In the past the Award was made for such notable achievements as the development of synthetic rubber and the pioneering production of Streptomycin and vital medicinals. The Dow Chemical

Company, one of its parent firms, was so honored for its process for recovering magnesium metal from sea water in 1941.

The present award represents the first time this citation has been given to a company for the successful participation of its chemical engineers in the commercial development of new products, markets and sales, as well as for their contribution to silicone process research and development. Successful commercial development of silicones has led to one result very dear to the consumer's heart: a drop in price of as much as 40% in a decade. The same figure also represents

the corporation's average yearly growth rate, as opposed to about 9% for the entire chemical industry. Its gross sales have jumped from \$15,000 per month in 1943 to a current rate of over \$2 million a month.

Formal presentation of this award in December will set the seal of public acclaim upon the achievements that have turned a cow pasture on the Tittabawasee into the home of some of the greatest miracles of modern science.

Our thanks are extended to the Dow Corning Corporation for the information on which this article was based, and particularly for their thoughtful checking of the article once written.

WHAT MAKES AN ECONOMIST

To be a complete economist, a man need only be a mathematician, a philosopher, a psychologist, an anthropologist, a historian, a geographer and a student of politics; a master of prose exposition; and a man of the world with experience of practical business and finance, an understanding of the problems of administration and a good knowledge of four or five foreign languages. All this in addition, of course, to familiarity with the economic literature itself. This list should, I think, dispose at once of the idea that there are, or ever have been, any complete economists, and we can proceed to the practical question of what arrangements are likely to provide us with men who will feel not wholly confounded when an important economic decision confronts them. . . . But there is one thing I have not mentioned. The good economist is like a bottle of wine. He must begin by having the luck to be laid down, as it were, in a vintage year, when he himself and his class companions are the high-quality stuff in which ideas and theories ferment and discourse sparkles in a glow of golden light. But this is not enough. He must mature.

From *UNCERTAINTY IN ECONOMICS* by G. L. S. Shackle (1955). Quoted by permission of Cambridge University Press, the publishers.

THE STATEMENT OF CHANGE IN WORKING CAPITAL

By STUART B. MEAD*

This is not directed primarily to accountants. Stockholders will find this type of statement helpful, although most corporations have not yet adopted it.

While the law does not require the officers of a corporation to report complete details of corporate affairs, both candor and good business sense urge that primary facts should be clearly presented if good stockholder relations are to be maintained. This may be accomplished in various ways. An earlier article in *Business Topics*¹ dealt with more intelligible financial statements; the present one considers a possible supplement to these statements.

Due to their conciseness, published balance sheets and income statements leave many important questions unanswered. Looking over a sheaf of annual statements an investor or business man might well ask, "Why can the Bar-None Grommet Company report a healthy profit and yet show a weakened current position?" Again, our questioner may be interested in discovering how the Blow-Your-Own Gasket Corporation shows a large increase in its cash reserves while operating at a loss. Upsy-Daisy Margarine's data do not specify how they are financing that new 5-story addition they exhibit in four colors on the cover of their annual report. The frustrated stockholder feels he has a right to know these things, and alert executives agree. How are these failures of communica-

tion to be corrected? The Statement of Change in Working Capital is one means available.

Even though the statement has been in use for many years, it is still in an experimental stage as far as title and form are concerned. The statement is also neglected in corporate reports. According to the American Institute of Accountants² only 110 corporations of the 600 whose reports were studied made use of the statement in their 1953 annual report. In these corporate reports a number of varying titles are used for this statement. In addition to Statement of Change in Working Capital it often appears as Statement of Funds or Statement of Source and Application of Funds.

The customary title and the one used most frequently in reports is "Statement of Funds". A number of corporations are avoiding this title due to the fact that *funds*, to most people, means *cash*. Such an interpretation of the statement leads to confusion, and even to hard feelings if the reader has leaped to the conclusion that these funds are about to be distributed. Actually the statement deals with those financial changes that affect *working capital*, and thus differs from a statement of cash receipts and disbursements. The statement of receipts and

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1) "What Makes It Balance?" *Business Topics*, January, 1954.

2) "Accounting Trends and Techniques", 1953 Edition, American Institute of Accountants: New York.

disbursements shows the total amounts of cash received and the total amounts of cash paid out. The statement of change in working capital shows the sources of new business resources and their investment.

Purpose of Statement

The purpose of the statement of change in working capital is to explain how the non-current assets and liabilities were manipulated to contribute to a change in the working capital of the business. Working capital, of course, represents the excess of current assets over current debt. While the statement is concerned with balance sheet data, the emphasis is shifted from that of relative total financial position to an analysis of causes of change in current financial position. The statement also makes use of income data for the period.

In view of the purpose as stated above, the statement should start with the sources of funds. The basic source is the gross receipts or sales of a business. Funds are also provided by the sale of capital stock, by borrowing through the issuance of long-term securities, or by the sale of fixed assets on long-term investments.

A listing of the various sources should be followed by the disposition of these funds. The uses of the funds include the various expenses incurred by the business, the purchase of fixed assets or long-term investments, the retirement of long-term debt and the payment of dividends. In connection with the expenses it is important to use only those that involve a current outlay of funds. Depreciation is an expense arising from an application of funds in past periods, and would be excluded from the current expenses requiring a use of funds. While depreciation re-

flects the necessary current charge against sales, it requires no current absorption of funds.

To illustrate the nature of depreciation in its relationship to the statement of change in working capital, assume that John Brown owns his own service station. During the month of April, 1955, Brown purchases 6,000 gallons of gasoline at \$.20 per gallon, and sells all of it at \$.30 per gallon. The service station cost \$3,000 to build. The estimated life of the station is set at ten years. On the basis of these facts, depreciation would be \$25 per month. An income statement for April might be shown as follows:

John Brown Statement of Income Month of April, 1955	
Sales (cash)	\$1,800
Less: Cost of gasoline sold (cash.)	1,200
Gross profit on sales	\$ 600
Less: Depreciation on station	25
Net income	\$ 575

The above illustration, for purposes of simplicity, has disregarded normal operating expenses. These expenses would only complicate, not change, the problem. Assuming that Brown started business on April 1 with cash of \$1,000 and the service station, his balance sheets on April 1 and April 30 would appear as follows:

John Brown Comparative Balance Sheets			
	April 30, 1955	April 1, 1955	
Cash	\$1,600	\$1,000	
Service Station	\$3,000	\$3,000	
Less Depreciation Allowed	25 2,975	0 3,000	
John Brown, Investment	\$4,575	\$4,000	

It should be noted that Brown's investment increased by the amount of net income (\$575), while cash increased by \$600, the net increase in working capital. Depreciation should, therefore, be disregarded in the statement of change in working capital.

FIVE-YEAR SUMMARY OF CHANGES IN CONSOLIDATED WORKING CAPITAL

	(Thousands of dollars—000 omitted)				
	1954	1953*	1952*	1951*	1950*
SOURCES OF FUNDS					
Sales of crude oil, products, and services	\$5,662,000	\$5,522,000	\$5,285,000	\$4,721,000	\$3,832,000
Income from investments	144,000	109,000	86,000	73,000	55,000
Proceeds from sales of properties	31,000	34,000	21,000	25,000	39,000
Others (net)	31,000	(41,000)	11,000	12,000	24,000
Total funds received	5,868,000	5,624,000	5,403,000	4,831,000	3,950,000
DISPOSITION OF FUNDS					
Spent for oil, materials, and services bought from others .	3,598,000	3,412,000	3,296,000	2,815,000	2,269,000
Wages, salaries, and employee benefits	804,000	779,000	750,000	677,000	606,000
United States and foreign taxes	433,000	485,000	451,000	450,000	319,000
Additions to property, plant, and equipment	600,000	587,000	565,000	443,000	352,000
Dividends paid to Jersey shareholders	280,000	272,000	257,000	250,000	151,000
Dividends paid to minority shareholders of affiliates . .	42,000	45,000	46,000	42,000	34,000
Net change in long-term borrowings	35,000	(29,000)	(35,000)	(4,000)	28,000
Total funds used	5,792,000	5,551,000	5,330,000	4,673,000	3,759,000
INCREASE IN WORKING CAPITAL	\$ 76,000	\$ 73,000	\$ 73,000	\$ 158,000	\$ 191,000

*Restated for purposes of comparison to include affiliated companies in Europe and North Africa.

The Statement Illustrated

A statement of change in working capital has been reproduced from the 1954 Annual Report of the Standard Oil Company (New Jersey).

The statement exemplifies the ideas already set forth in this article. The primary sources are sales, investment income and disposal of fixed assets.

The funds are used for current expenses (excluding depreciation), additions to fixed assets, payment of dividends, and decrease of long-term debt.

To stress the point that this type of statement has not been standardized, an alternative form taken from page 24 of the 1954 Annual Report of the General Electric Company is reproduced below.

	(Amounts in millions)		
CHANGES IN NET WORKING CAPITAL DURING	1954	1953	1952
NET WORKING CAPITAL AT JANUARY 1	\$370.4	\$398.7	\$352.5
ADDITIONS:			
Net earnings for the year	212.6	165.7	151.7
Depreciation of plant and equipment	79.5	67.3	59.7
	<u>662.5</u>	<u>631.7</u>	<u>563.9</u>
DEDUCTIONS:			
Expenditures for plant and equipment	158.8	141.0	123.1
Dividends on common stock	131.4	121.6	85.9
Net Advances to Nonconsolidated Affiliated Companies	19.7	6.9	46.2
Increase in holdings of Treasury Stock for corporate purposes	14.2	2.4	3.4
All other—net	14.6	10.6	1.0
	<u>338.7</u>	<u>261.3</u>	<u>165.2</u>
NET WORKING CAPITAL AT DECEMBER 31	\$323.8	\$370.4	\$398.7

Instead of showing the net increase (or decrease) of working capital, this statement starts with the working capital figure at the beginning of the year and ends with the same figure at its close. The report also shows net earnings for the year rather than the gross receipts and current expenses. As a consequence, depreciation, for the reasons outlined above, must now be added to the reported net income.

In its report the Company makes the following statement: "The source and use of working capital are tabulated below. The additional working capital required for increased plant expansion and modernization expenditures in those years is clearly shown."

Summary

In view of an increase in emphasis upon public relations, corporations should attempt to give the stockholders all of the important financial facts. The Statement of Change in Working Capital affords important data not obtainable from the other statements. General Electric's financing of plant expansion through working capital is an apt illustration. The balance sheet does not bring out this detail. Through more understandable statements all parties interested in the activities of a corporation will be better served.

Thanks are extended to The Standard Oil Company (New Jersey) and to the General Electric Company for permission to reproduce the two summaries.

Do You Know These Michigan Towns?

1. In a still undiscovered spot just off this Fruit Belt city the grain ship Chicora sank with all hands in a gale in January 1895, within sight of the famous sand dunes.
2. This is the only town in Michigan on the 45th parallel; it is a county seat of an area with large deer and small human population.
3. The magic capital of the world, this town does not have to depend upon sleight-of-hand to charm the eye of the visitor. The name is the Spanish form of the Italian name of a great explorer whose hobby was magic tricks. Pure coincidence.
4. Widely known as The Friendly City, it boasts as a landmark the romantic castle built by a best-selling author and native son. It also gave the Empire State one of its most prominent governors. And its up-to-date school system could be a model for us all in our own communities.
5. As far as we know this is the only city in the world to have a strain of poliomyelitis virus named for it. One of the most expensive fires in the state made news here a few years ago. But all is not disaster: the city has several times won the coveted title of America's Safest City.

(For the answers, see page 24.)

IT BLOWETH WHERE IT LISTETH

The weather always was a good topic of conversation, but in recent years it seems to provide more matter for argument than ever before. Are winters as severe as they were in Grandfather's day? Are experiments with atomic fission raising hob with the climate? And lastly, atoms or not, are we getting more tornadoes than we used to? We donate these three questions to our readers to fling into the next low-pressure area in conversation. As to the first one: we are apparently in a definite cycle of increasingly mild climate. Any one winter may prove an exception, but the trend for half a century and more has been to less severe weather. Second question? Your guess is as good as ours. Take either side of the argument.

As to the third query, we really do have some data from a firm that should know what it's talking about. This is the Michigan Mutual Windstorm Insurance Company of Hastings, Michigan, the oldest and largest of its kind in Michigan, and the second largest in the world. It handles only windstorm coverage, and that only within the state. Its 110,000 members are mostly rural, and they are covered to the impressive extent of \$900,000,000. A really big windstorm loss for this company is felt as far away as England, for they carry an excess loss policy for their own protection with Lloyds' of London. There aren't many big winds that have blown across the state since 1885 that the Michigan Mutual Windstorm hasn't paid out money on. That means plenty of storms, for our state, though supposedly in the "temperate" zone, lies within the tornado belt, and hence is subject to the most violent wind disturbances in the world.

According to the records, we *do* get more tornadoes than we used to: this amount is measured by the ratio of claims to membership, for of course dollar-wise the claims have gone up with the periods of inflation and hence do not reflect the incidence of wind. Each year since 1950 has shown an increase in the number of claims, from 6,400 in 1951 to 16,000 in 1954. However, a single storm, that of Armistice Day in 1940, brought in 30,000 claims—and the \$1,250,000 it cost the company would be tripled at today's prices. That storm was not a tornado, but a widespread steady blow over much of the state, reaching a *sustained* 80 miles per hour velocity in Grand Rapids. (The Weather Bureau measures wind velocities that continue over a period of five minutes or more, and not gusts—so the burst of wind that took off your cellar door that day may have been traveling much faster.)

1953 was the year of the Flint tornado, as we all have reason to remember. The Michigan Mutual Windstorm was not involved in much of that terrific loss, for most of the damage was to urban property not covered by this company. You will recall there was other damage that afternoon—at least two tornadoes in the Monroe-Toledo region. One of these proceeded down Temperance Road near Monroe for six miles before it hit Lake Erie. In that distance it took with it everything that lined the road: barns, trees, poles and wires, even substantial brick homes, and left only rubble. What was the wind velocity? No one has ever measured the force of a tornado, for it has a way of destroying weather station equipment along with everything else.

The Michigan Mutual Windstorm Insurance Company owes its location in the pleasant town of Hastings simply to the fact its founder lived there. The town looks like the last place in the world to be concerned about disasters, for its tree-lined streets and tranquil old homes imply calm and permanence rather than the destructive power of nature. The company itself bears out the impression of permanence and stability. Its coverage is statewide, in the

hands of some 700 agents. In contrast with the sharp rise in rate that the New England insurance companies instituted after last fall's severe hurricanes, this Michigan firm maintains its low rate and periodically broadens its coverage.

ANNE C. GARRISON

Information on the Michigan Mutual Windstorm Insurance Company was kindly supplied by its President, Mr. Orr G. Stanley, of Hastings, Michigan.

100 YEARS TO MOVE A MOUNTAIN

Everyone seems to be having centennials. Sault Ste. Marie is celebrating the hundredth anniversary of the opening of its world-famous locks. To dramatize the amount of traffic that has passed through since 1855, their centennial committee has estimated how large a mountain would be formed by the total amount of ore handled by the locks in that time. Piled in one place, it would form a symmetrical heap with a base 3.6 million square feet, and towering 14,945 feet, the height of Mount Whitney, tallest in the country. 1.5 billion tons of pig iron has been made from that ore.

Beginnings were modest: the brig "Columbia" carried the first 132 tons simply piled on deck. Average cargo today is nearly 14,500 net tons. The record tonnage of ore was 98.4 million tons in 1953.

The figures are still more startling when it is considered that ice closes the locks for several months of every year. In spite of this fact, the canal carries more tonnage a year than the combined Panama, Suez, Manchester and Kiel canals.

The Soo was an old town even when the locks were opened. Only two other communities in the country have enjoyed a longer period of continuous settlement. Anybody like to try to name them?

ANSWERS TO "Do You Know These Michigan Towns?"

(From page 22)

1. South Haven;
2. Atlanta;
3. Colon;
4. Owosso;
5. Lansing.

Current Michigan Business Conditions

The Fall months have continued to experience the strong economic conditions that have prevailed during the entire year to date. Some fluctuations in general activity were in evidence during the period of the automobile model changeovers and the preceding preparations. Consequently, some unevenness was noticeable during late August, September, and October in manufacturing employment and in the level of unemployment. The advent of the 1956 models, with production scheduled at full capacity, was accompanied by a continued surge of business activity throughout most of the State.

Nation's Business. Nationally there have been some conflicting forces influencing the economic scene. The President's illness caused immediate repercussions in security and some commodity markets. The large city major banks have recently raised their prime interest rates from $3\frac{1}{4}$ to $3\frac{1}{2}$ percent, this being the minimum cost of credit that is available only to highest credit risk business borrowers. Residential construction, as measured by the number of contract awards, declined during August and September—and, in September, was below the 1954 level for the first time this year. This reduction may have been a reflection of the restrictions on credit imposed by both the Federal Housing Administration and the Veterans Administration regarding down payments and loan periods. Receipts for agricultural commodities were more than 4 percent below the first 9 month level of 1954, continuing the downward trend which began in 1951.

On the other hand, industrial production continued to advance during the Fall months. The Federal Reserve Board's seasonally adjusted index of industrial production reached a record 141 percent of the 1947-49 average during September. The increase in automotive and related production and the substantial level of steel production (at 96 percent of rated capacity during September) have been the leaders in this advance. Non-residential construction hit an all-time monthly high of \$4 billion in September and set a new quarterly record as well. Total U.S. employment at 64,700,000 was the highest September on record, while unemployment dropped to 2,100,000 during the month—the lowest since 1953.

Retail trade continued at a brisk pace with department store sales about 7 percent ahead of a year ago during September. High consumer income and the continued heavy use of credit are supporting retail buying at record levels. Total consumer credit increased an estimated \$657 million during September, reaching a national total of \$34,293 million at the beginning of October. At the present time, retailers are looking forward to an excellent Fall season and, probably, the best Christmas season on record.

The general national business situation was well described by Arthur F. Burns, chairman of the President's Council of Economic Advisers, when he said in a recent speech that the U. S. "is poised on a high plateau with neither the threat of inflation nor of recession . . . ever very distant."

Michigan's Business. The picture throughout Michigan has been good, with some fluctuations caused by automobile changeovers being the most important factor in the employment picture and influencing general business conditions.

Statewide factory employment dropped to 1,140,000 in mid-August, for the lowest point in 1955. Despite this low, the August figure exceeded any month's total in 1954, excepting January. In mid-September, factory employment dropped further to 1,128,000. During September, most of the major model change layoffs had occurred; and, by month end, substantial recalls were in process in the Detroit area. The layoff peak outstate was expected in late October because of the delayed impact of model-change schedules. Non-manufacturing employment showed its seventh successive monthly increase and climbed to 1,171,000 during September. This figure broke the all-time peak of non-manufacturing employment established during the previous month.

Unemployment also reflected the automotive situation. Michigan unemployment reached 130,000 in mid-August and 138,000 in mid-September, but this was considerably below the 1954 level. The dominant segment in the unemployment picture during August and September was the Detroit Metropolitan Area where practically all of the increase in unemployment took place. The impact of model-changes shifted gradually to the outstate areas during October when slight increases in unemployment took place.

Bank debits in practically every major center of the State were substantially above 1954 figures. In Lansing, September bank debits were 31 percent above 1954, while Detroit was 27 percent above 1954. Bank loans and deposits in the Lower Peninsula banks continue also significantly above 1954. Detroit banks that are Federal Reserve members had total loans and discounts of \$1,218,000,000 at the end of September, which was 24 percent above a year ago; other Lower Peninsula banks that are members of the Federal Reserve System had total loans and discounts of \$1,214,000,000 at the same time, which was 19 percent above a year ago. Demand deposits in Detroit Federal Reserve members at the end of September were 12 percent above a year ago, while other Lower Peninsula Federal Reserve members had total demand deposits 10 percent above a year ago. Time deposits (savings accounts) were not running as far ahead of last year; Detroit banks were 3 percent above 1954 at the end of September, while the other Lower Peninsula Federal Reserve members were running a total of 8 percent over a year ago.

Automobile production, headed for its first 8 million passenger car year, has been breaking all production records and exceeding even the most optimistic forecasts at the beginning of the current year. The drop in production during the month of August and September gave September the lowest production figure for the year. The total production through September of 1955 had already exceeded the entire year of 1954 and was exceeded only by the yearly totals for 1950 and 1953. Motor vehicle factory sales in the first three quarters of the year reached 6,908,079. The sales record during 1955 has been outstanding in moving such a high volume of vehicles; however, the question is frequently raised whether or not the market can continue to absorb new automobiles at such a record pace.

Retail trade has continued at substantially high levels throughout the Fall season. Following small seasonal decreases during the Summer months, an almost record spurt took place during September. Preliminary figures of the Michigan Department of Revenue indicate that September's business (as meas-

ured by sales and use tax collections) was exceeded *only* by the 1954 Christmas season. September's business appeared to be a full 25 percent above 1954. Department store sales in the state's major centers were also at or near record levels during September. For the entire State, department stores in the first 9 months were running 11 percent above the same period in 1954. In this 9 month period, department store sales in Battle Creek were 30 percent above 1954; in Lansing, 21 percent above 1954; and in Detroit, 12 percent above 1954. The substantial spurt in retail trade during the Fall months leads many to look forward to a record Christmas season.

Bank Debits

City	Bank Debits (thousands of \$'s)			Percent Change from Previous Year		
	July '55	Aug. '55	Sept. '55	July '55	Aug. '55	Sept. '55
Adrian	23,346	22,470	22,595	+ 28.5	+32.5	+28.9
Battle Creek	73,256	71,993	71,626	+12.9	+16.9	+11.5
Bay City	50,439	50,241	52,632	+ 5.5	+ 8.5	+17.3
Detroit	5,791,468	6,165,991	5,901,908	+22.8	+22.5	+26.7
Flint	167,227	176,822	178,845	+15.9	+29.7	+22.6
Grand Rapids	291,064	314,515	317,946	+ 7.8	+15.6	+15.2
Jackson	87,053	95,548	92,876	+19.7	+29.3	+28.0
Kalamazoo	119,326	127,525	125,246	+18.3	+23.1	+17.1
Lansing	151,739	151,969	156,546	+10.5	+26.8	+31.0
Muskegon	80,604	79,265	81,290	+15.6	+18.2	+17.3
Port Huron	42,062	44,561	40,975	+ 5.0	+22.6	+21.8
Saginaw	118,322	119,482	116,178	+18.0	+15.7	+16.6
Escanaba	10,932	11,280	11,374	+ 6.1	+11.6	+18.1
Marquette	11,554	12,979	12,100	+ 6.7	+20.3	+12.1
Sault Ste. Marie	11,249	12,718	11,344	+ 0.5	+ 5.3	- 4.9

Source: Federal Reserve Banks of Chicago and Minneapolis

Department Store Sales

	July 1955		August 1955		September 1955		Jan. - Sept. 1955 vs. 1954
	Percent Change from June '55	July '54	Percent Change from July '55	Aug. '54	Percent Change from Aug. '55	Sept. '54	
Battle Creek	-10	+34	+ 2	+28	+11	+38	+30
*Detroit	-16	+13	+14	+17	+12	+16	+12
*Flint	-12	+18	+18	+22	+ 1	+17	+13
*Grand Rapids	-16	+ 4	+24	+ 3	+14	+ 6	+ 2
*Jackson	-20	+11	+28	+18	0	+ 7	+ 8
*Kalamazoo	-20	+ 4	+29	+ 3	+ 1	+ 5	+ 4
*Lansing	-10	+27	+16	+33	+17	+31	+21
Muskegon	-13	+11	+ 5	+11	+17	+10	+11
Port Huron	-17	+ 5	+22	+12	+17	+11	+ 8
*Saginaw	-16	+ 7	+30	+12	- 4	+11	+ 7
*Metropolitan Areas							

Source: Federal Reserve Bank of Chicago

Motor Vehicle**Factory Sales****From Plants in U.S.**

	Factory Sales			Percent Change from Previous Year		
	July '55	Aug. '55	Sept. '55	July '55	Aug. '55	Sept. '55
Passenger Cars	658,736	620,610	467,845	+45.8	+39.4	+55.4
Motor Trucks and Buses	109,885	95,553	92,117	+39.5	+25.5	+33.6

Source: Automobile Manufacturers Association

**Electric Sales in
Kilowatt Hours**

	Thousands of KWH Sales			Percent Change from Previous Year		
	June '55	July '55	Aug. '55	June '55	July '55	Aug. '55
Residential	458,161	455,531	456,606	+ 6.4	+11.3	+11.6
Commercial	291,400	292,390	317,228	+13.5	+10.7	+18.9
Industrial	915,246	857,370	938,749	+29.2	+34.6	+38.9

Source: Edison Electric Institute

**Non-Farm
Employment**

	State of Michigan	Detroit Met. Area	Flint	Grand Rapids	Lansing	Saginaw	Upper Peninsula
June 15, 1955	2,558,000	1,444,000	140,700	118,800	79,900	58,300	80,000
July 15, 1955	2,560,000	1,445,000	137,800	118,700	78,900	58,500	81,300
August 15, 1955	2,524,000	1,408,000	138,100	118,100	78,700	58,400	81,900
Sept. 15, 1955	2,524,000	1,402,000	139,200	117,900	80,200	58,500	82,600

Percent Change from Year Ago:

June 15, 1955	+6.1	+7.1	+7.8	+3.9	+2.8	+4.1	-0.2
July 15, 1955	+6.5	+7.8	+6.8	+3.7	+3.5	+4.5	-0.6
August 15, 1955	+5.3	+5.6	+7.7	+3.4	+5.2	+4.1	-1.3
Sept. 15, 1955	+8.2	+9.1	+16.4	+3.1	+7.8	+10.8	+0.2

Total Unemployment

June 15, 1955	88,000	52,000	3,100	3,000	1,700	1,000	7,600
July 15, 1955	97,000	57,000	3,600	3,500	2,700	1,100	6,000
August 15, 1955	130,000	91,000	3,200	3,700	2,500	1,000	4,900
Sept. 15, 1955	138,000	101,000	3,600	3,600	2,100	1,000	4,200

Percent Change from Year Ago:

June 15, 1955	-58.9	-61.5	-22.5	-53.1	-60.5	-58.3	-35.0
July 15, 1955	-58.2	-62.0	-18.2	-52.1	-58.5	-57.7	-50.5
August 15, 1955	-44.7	-40.5	-30.4	-51.9	-49.0	-61.5	-45.6
Sept. 15, 1955	-51.9	-48.2	-70.5	-49.3	-56.2	-81.8	-54.3

Source: Michigan Employment Security Commission

MARVIN HOFFMAN

Per Capita Americanus, in one way or another, now manages to get rid of some 390 pounds of paper annually. This includes the quantities he requires to litter his streets, his currency, the comic books necessary for the edification of his soul—and possibly the shoes, if they cost less than \$20 the pair, needed for the protection of his soles. Somebody—and we're blessed if we know how he nailed this statistic firmly to the barn door—says that the average citizen or comrade, as the case may be, in the rest of the world chews up only 10 pounds of paper per annum. It is axiomatic that the civilization of nations is in direct ratio to their consumption of paper. Hence, if you are in a frisky mood, you can reasonably jump to the comforting conclusion that we are 39 times as civilized as the remainder of mankind.

(quoted from *Better Impressions*, one of the brightest publications we know; it is an organ of the Mead Company, Dayton, Ohio.)

1956 EXECUTIVE MANAGEMENT PROGRAM

The College of Business and Public Service of Michigan State University will offer its four-week 1956 Executive Management Program in two two-week periods—February 13-25 and March 5-17.

This is the second annual program in general administration for experienced executives. It is designed to encourage the development of the individual and his ability to think creatively to meet new and changing conditions.

The objectives of the program are:

- (1) to help executives function more effectively in their present positions,
- (2) to aid executives to prepare for the possibility of assuming greater future responsibilities and
- (3) to assist business enterprises in the building and perpetuating of a highly competent management organization.

For additional information, please write:

Ward J. McDowell, *Director*
Executive Management Program
Business Administration Building
Michigan State University
East Lansing

BUSINESS RESEARCH PUBLICATIONS

The Bureau of Business Research was established in 1951 to assist the Michigan State University faculty in conducting economic and business research and to serve Michigan business with information and studies. The studies are usually published, and those currently available are listed below. Inquiries should be addressed to the Bureau's director. Where applicable, draw checks payable to Michigan State University.

RESEARCH REPORTS

9. *Careers in Hotel and Restaurant Management (Free)*
10. *What Michigan Newspapers Tell About the Schools (Free)*
11. *Winter Resorts in Michigan (\$1.00)*
12. *Taxation of Mobile Homes (\$1.00)*
13. *Wages, Hours, and Fringe Benefits in Member Stores of the Michigan Retail Hardware Association (\$1.00)*
14. *Michigan County Market Data (Free)*

15. *Michigan Statistical Abstract (\$3.00)*

A handy compilation of the most recent statistics on Michigan and its subdivisions. Ten major classifications of data, 179 pages, concerning the economic, social and physical aspects.



